at α. If N_2^6 be projected from α it becomes a Kummer surface. There is a family of ∞^3 surfaces M_2^{18} with the same $G_{2\cdot 81}$. By projection we obtain a family of N_2^6's whose node α runs over a quartic spread J_4—the simplest invariant of G_{25920}. The 10 points in the S_4 of I run over the Hessian J_{10} of J_4. The spread J_4 is its own Steinerian and the polar cubic of a point α on J_4 as to J_4 is a Segre cubic spread with nodes at the 10 points on J_{10}, and of course a simple point at α. The point α on its polar cubic determines a binary sextic—the fundamental sextic of the hyperelliptic functions. In this way the solution of the form problem of G_{25920} in terms of hyperelliptic modular functions becomes apparent at once *in the special case* when $J_4 = 0$. This restriction is removed later by a conventional method. The conclusions above all are drawn from the existence of a set of 9 quadrics whose complete intersection is the normal spread M_2^{18} and whose coefficients are the modular forms α.

The above determination of the lines of C^3 differs from that of Klein[3] in that no equation of degree 27 or other resolvent equation is employed. All the processes are effected within the domain of the invariants and linear covariants of C^3. Klein also uses as fundamental form problem that of the Maschke collineation group in S_3 rather than the Burkhardt form problem. This implies the isolation of a root of the underlying binary sextic. The accessory irrationalities required are thereby somewhat simpler.

[1] These PROCEEDINGS, **1**, 245 (1915); *Trans. Amer. Math. Soc.*, **16**, 155 (1915). This series of investigations has been pursued under the auspices of the Carnegie Institution of Washington, D. C.

[2] These PROCEEDINGS, **2**, 244 (1916); *Trans. Amer. Math. Soc.*, **17**, 345 (1916).

[3] That an equation of degree 27 for the lines of a cubic surface could be solved by hyperelliptic modular functions was first pointed out by Klein, *J. Math.*, *Paris*, Ser. 4, **4**, 169 (1888). His suggestions were elaborated by Witting, *Math. Ann.*, *Leipzig*, **29**, 167 (1887); by Maschke, *Ibid.*, **33**, 317 (1889); and by Burkhardt, *Ibid.*, **35**, 198 (1890), **38**, 161 (1891), **41**, 313 (1893).

THE INTERFERENCES OF SPECTRA BOTH REVERSED AND INVERTED

By Carl Barus

DEPARTMENT OF PHYSICS, BROWN UNIVERSITY

Received by the Academy, September 6, 1916

This is an interesting combination of the two methods of investigation hitherto given (Carnegie Publications, No. 249, 1916, §4) and not very difficult to produce. Retaining the adjustment for inverted spectra

the white light impinging on the grating is previously dispersed, preferably by an Ives direct vision grating (with auxiliary prism). The rulings of both gratings (the Ives grating being between the collimator, at some distance, and the first grating of the interferometer) are to be parallel. If the grating constants D_1 are different ($D = 167 \times 10^{-6}$ cm. film, and $D = 352 \times 10^{-6}$ cm. ruled grating, were employed) the spectra in the telescope are naturally of different lengths: for the dispersion of the Ives grating is increased on one side and decreased on the other side, by the grating of the interferometer. Moreover this decrease from the larger dispersion of the first grating is beyond zero (achromatism) into negative values. Hence the corresponding duplicate spectrum in the telescope is a small spectrum with a large spectrum reversed relatively to it, while the inversion remains intact. In the experiment made, the larger doublet, D'_1 D'_2, was somewhat more than twice as broad as the smaller D_1 D_2.

It is now merely necessary to place any longitudinal axis (line of symmetry) of the two spectra seen in the telescope in contact; or it is but necessary that the spectra are longitudinally parallel and overlap. The phenomenon then appears at the intersection of the lines of longitudinal and of transverse symmetry. It is thus proportionately nearer the smaller D_1 D_2 and farther from the larger D' D' doublets, but always between them. If the D_1 D_2 lie within the D'_1 D'_2 lines, the fringes lie within the D_1 D_2 pair.

The phenomenon which should be observed with a powerful telescope, usually consists of three or fewer small elongated dots, lying within an elliptic locus, the locus usually having a transverse axis (parallel to the Fraunhofer lines) about two or three times as long as the longitudinal axis (parallel to lengths of spectra). Usually the width was D_1 D_2 and the length larger than D'_1 D'_2, but this ratio may be changed by screening off the wavefront. The fringes were not more than one-half of D_1 D_2 apart.

The interesting result is here again met, incidentally, that spectra from the same white source, though of different lengths, are nevertheless quite capable of producing strong interferences on overlapping.

In further experiments with the long collimator and very bright spectra, a variety of other forms was obtained. In most patterns the elliptic outline, sometimes circular, is always evident from the enhanced brightness of the bright fringes of the spot. As any adjustment of overlapping spectra suffices, the D lines may be quite out of the field, or the spectra may be slightly separated with the interference spot in the gap.

The experiment was also made of crossing the spectra at some other angle than 0° or 180°. For instance, the rulings of the Ives grating were placed at right angles to those of the interferometer grating, as in Newton's method of crossed prisms. Seen in the telescope (adjusted for inverted spectra) the two spectra now made an elbow with each other, while the D_1 D_2 lines were still parallel and could be put in coincidence. On using a long (meter) collimator, strong interferences were obtained in the line of symmetry of the elbow and normal to the D lines. They have the same characteristics as the preceding and persist during a displacement of mirror of about 0.3 cm.

SEX INTERGRADES IN A SPECIES OF CRUSTACEA

By Arthur M. Banta

STATION FOR EXPERIMENTAL EVOLUTION, CARNEGIE INSTITUTION OF WASHINGTON

Received by the Academy, August 30, 1916

In unisexual forms we are accustomed to think of the term male as signifying the possession by the animal indicated not only of a sperm-producing organ and the associated accessory male reproductive structures but also of certain definite secondary sex characters, definite characters of form and structure and, further, of conspicuous physiological and psychological characteristics. The term female implies definite and marked characters contrasting with those of a male on all these points. In other words maleness and femaleness are generally taken to indicate definite and precise opposed and alternative states, only one of which may obtain in a single individual.

The occurrence of known deviations from the conditions of maleness and femaleness are in the main confined to a comparatively few isolated and sporadic cases of hermaphroditism and gynandromorphism. Gynandromorphs are really sex mosaics inasmuch as a definite portion of the body, frequently one-half, possesses *in toto* the definite characters of one sex and the remainder of the body is distinctively of the other sex. However two workers have published concerning stocks in which considerable numbers of individuals are intermediate in their sexuality—intermediate not as sexual mosaics but quantitatively and as a whole different from either the normal male or the normal female. Riddle[1] has demonstrated intermediate sex forms in his pigeons and Goldschmidt has obtained such forms in the offspring of certain crosses in the gypsy moth.

In a species of crustacean the writer has obtained intermediate sex forms (for which the term *sex intergrade* seems appropriate) constitut-